| | |
|---|---|
| Gas stream refrigeration load equivalent (Tons): | 6.14 |
| Air-cooled chiller unit power input energy (kWh): | 8.60 |
| Adsorption compressor power savings (kWh): | |
| (Table 2 value 47.01 kW -Table 3 value 40.96 kW) x I Hr. | 6.05 |
| Total net added power required by system (kWh): | 2.55 |
| Total net added power for 3.75 ton/Hr oxygen (kWh/Ton rate): | 0.68 |

While the invention has been described in its preferred embodiments, it is appreciated that system and apparatus variations may be made to maximize gas separation performance of numerous individual available molecular sieve materials that can be chosen for efficient separation of gases at various system TPD rated capacities and site conditions, without departing from the scope and spirit of the invention.

I claim:

1. A pure vacuum swing gas adsorption system and apparatus means for use in the separation of one or more desired molecular gases from a supplied feedstock stream of mixed molecular weight gases of greater number, the said gas separation system and apparatus means hereafter referred to as the Pure VSA Separation System comprising:

(a) a combined system design and apparatus means therein collectively performing both a gas adsorption and a gas desorption operational sequence to achieve the desired efficient separation of gases;

(b) a unique design of adsorption-desorption assembly apparatus;

(c) gas compressors having high gas compression efficiencies;

(d) a combined system and apparatus means wherein gas flows within both the adsorption and desorption sequential operations are flow-induced by low absolute

pressure conditions created by gas compressors conduit-positioned downstream from the adsorption-desorption assembly apparatus;

(e) an combined system and apparatus means where therein, particularly applied to air separation, both adsorption and desorption sequential operations can be ideally performed exclusively under vacuum pressure conditions to achieve minimum gas separation system power consumptions;

(f) Molecular sieve bed adsorbent materials that are chosen to selectively adsorb a given molecular gas or gases during the system's adsorption operation;

(g) Control system means by which the Pure Vacuum Adsorption Separation System's operational steps are sequentially controlled, operating parameters of gas stream flows are monitored for safe operation, and system gas product flow is controlled to meet a given supported remote process demand;

2. A unique adsorption-desorption assembly apparatus of claim1 wherein gas flows are radially directed through the chosen molecular sieve gas adsorption material, and further comprising:

(a) a cylindrical outer shell assembly having a preferred length to diameter ratio greater than 2:1 and positioned in a preferred horizontal centerline-axis plane;

(b) a cylindrical assembly having mounted removable end-closure means on either one or both ends of the cylindrical outer shell;.

(c) an assembly therein containing either a 'fixed-type' cylindrical molecular sieve bed sub-assembly or a preferred cylindrical 'cartridge-type' molecular sieve sub-assembly;

(d) a directional flow of feedstock gases entering the molecular sieve bed can ideally be in a radially-inward direction and the desorption operation's flow of waste gases can ideally be in a radially-outward direction through the molecular sieve bed;

(e) a minimized bed depth of chosen molecular sieve gas adsorbent material;

3. A desired efficient separation of gases and high efficient gas compressors of claim 1, wherein alternative gas heat exchange means within selected gas streams can increase gas separation efficiencies and further reduce gas compressor power consumption.

4. A control system means of claim 1, wherein a alternative master PLC-based control panel comprises safety monitoring and control design features for the adsorption-desorption assembly apparatus, associated gas piping systems, and gas compression equipment, and further alternately comprising expandable control features for control integration with other plant site facility auxiliary system PLC control panels and the plant site facility's distributive control system (DCS).